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BULLETIN OF THE SCHOOL OF EDUCATION
INDIANA UNIVERSITY

Further Studies of Indiana University Motor Fitness Index

by
KARL W. BOOKWALTER

A List of Bulletins in the Field of Education, Indiana University

by
KATHLEEN DUGDALE

Published by the
BUREAU OF COOPERATIVE RESEARCH
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Further Studies of Indiana University Motor Fitness Index

KARL W. BOOKWALTER

PURPOSES OF THE PROJECT

A PREVIOUS study[1] to determine a simple, inexpensive measure of motor fitness revealed the suitability of the Indiana University Motor Fitness Index for this purpose. In that study suggestions for further investigation included:

1. To determine the merits of a mass-administered straddle chin as a substitute for the chinning on the high bar utilized in the present Indiana University Motor Fitness Index.
2. To determine the validity of an administrative classification of men of college age in which the above index would be the functional and primary measure and McCloy's Classification Index would be the structural and secondary measure.
3. To establish norms for Indiana University Motor Fitness Index for men of college age of various body types and Classification Index groupings.

It is the purpose of this study to carry on these three phases of the investigation. The former study will be used as a guide in the initial steps of selecting the items for criterion measures, but actual validation and computations will be made from currently obtained data.

NATURE AND SOURCE OF DATA

As in the former study, the present data are obtained from over 1,000 college men in the Indiana University physical fitness program. Previous criterion data included age, Brace test (Iowa revision), Burpee test (10 seconds), chins, Classification Index I, dips (on bars), drop-off (time on 440-yard run divided by time on 60-yard dash), 440-yard run, General Motor Capacity, General Motor Quotient, height, Larson's Dynamic Strength Test, Power I (chins-plus-dips times vertical jump—raw scores), Power II (hereafter titled I.U. Motor Fitness Index I), push-ups, 60-yard dash, standing broad jump, two-mile walk, vertical jump, and weight. The criterion against which the I.U. Motor Fitness Index was validated was the sum of the modified T-scores on the above 20 items.

VALIDATION OF PROPOSED MEASURES OF MOTOR FITNESS

As previously mentioned, the first study of the I.U. Motor Fitness Index recommended that the merits of the partner or straddle chinning as a substitute for chinning on the bar be determined. Recent

[1] Bookwalter, Karl W., and Bookwalter, Carolyn Weems. *A Measure of Motor Fitness for College Men*, Indiana University, Bulletin of the School of Education, Vol. XIX, No. 2, Bloomington, 1943, 26 pp.

communications with McCloy of the State University of Iowa indicate an interest in the possibilities of standing broad jump as a substitute for the vertical jump in the Motor Fitness Index. The aforementioned study seems to have reasonably established the validity of the general "power principle" in which the sum of the force measures (modified T-scored) is multiplied by a velocity measure (modified T-scored). Accordingly, it is proposed that the following four formulae (all utilizing modified T-scores) present the measures of most likely validity for our purpose and with the present criterion measure:

I. Chins-plus-push-ups times vertical jump (I.U. Motor Fitness Index I)
II. Chins-plus-push-ups times standing broad jump
III. Straddle-chins-plus-push-ups times vertical jump
IV. Straddle-chins-plus-push-ups times standing broad jump

Each of the proposed measures II, III, and IV would be administratively superior, by reason of cost or simplicity, to the present I.U. Motor Fitness Index if its validity were reasonably comparable to or higher than that of this previously proposed measure ($.831 \pm .03$). Accordingly, these four measures have been computed for all available cases and have been correlated with the criterion battery.

One new item has been added to the battery of items employed as a criterion in the previous study. This new item is straddle chinning, a modification suggested by the Rogers' technique of bar chinning from a half supine lying position. In the proposed modified chinning, the class is sized by height and paired to within approximately five pounds of their partner's weight. Numbers "one" lie on the floor supinely. They extend their arms on the floor directly sideward from the shoulders. The forearms are bent to vertical to enable the partners (numbers "two") to stand astride numbers "one" at the chest, facing them, and with their feet just outside and touching the elbows of numbers "one." Both partners keep their legs and back straight. They now grasp hands with bent finger grip. Numbers "one" flex their arms, chinning upward from a supine lie on the floor until their chests meet firm resistance with the thighs of numbers "two." The chinning is continued with supporting partners counting out loud until the chinners can do no more. Partners then exchange places and numbers "two" execute the chins. The obvious advantage of this technique is that it can be administered without equipment and on a mass basis.

The intercorrelation matrix in the previous study[2] reveals that the validity coefficients of age, Classification Index I, General Motor Quotient, height, and weight ran between $.088 \pm .03$ for General Motor Quotient and $.264 \pm .03$ for Classification Index I. It is evident that these measures consisting of or dependent upon structural or maturity factors have insignificant[3] validity coefficients. Similar low relationships for these items have been disclosed in other studies of college men. From the above results it might be concluded that the criterion of the present study should omit these items.

[2] *Ibid.*, p. 11.

[3] In this and the previous study of the I.U. Motor Fitness Index I, the following standards for correlations are followed: .0-.29 insignificant, .30-.59 low, .60-.79 considerable, .80-.89 high, and .90-1.00 very high.

TABLE I. RANK ORDER OF ZERO-ORDER CORRELATIONS FOR EACH ITEM AND THE CRITERION (20 ITEMS)

Age		Brace test		Burpee test		Chins		Classification Index		Dips		Drop-off	
Criterion	.231	G.M.Q.	.734	G.M.Q.	.515	Power I	.821	Weight	.756	Power I	.783	440-yard run	.301
Burpee test	.188	Criterion	.639	Criterion	.440	L.D.S.	.673	Height	.674	Chins	.599	Two-mile walk	.271
G.M.Q.	.180	St. brd. jp.	.473	G.M.C.	.410	Power II	.666	G.M.C.	.456	Criterion	.592	Power I	.249
Chins	.179	L.D.S.	.446	Power I	.310	Dips	.599	Criterion	.264	Power II	.590	Chins	.246
Brace test	.173	Power II	.399	Power II	.289	Criterion	.597	Power I	.108	Push-ups	.577	Criterion	.230
St. brd. jp.	.167	Power I	.365	L.D.S.	.288	Push-ups	.585	St. brd. jp.	.092	L.D.S.	.550	Power II	.227
Power I	.155	G.M.C.	.365	Brace test	.277	G.M.Q.	.421	G.M.Q.	.084	G.M.Q.	.427	Push-ups	.221
L.D.S.	.150	Push-ups	.357	St. brd. jp.	.274	St. brd. jp.	.416	Two-mile walk	.058	60-yard dash	.367	L.D.S.	.136
Push-ups	.140	Chins	.316	Vert. jp.	.272	440-yard run	.407	Push-ups	.057	440-yard run	.360	Burpee test	.133
G.M.C.	.135	440-yard run	.300	Push-ups	.261	Vert. jp.	.388	St. brd. jp.	.053	St. brd. jp.	.343	Brace test	.107
Dips	.131	Burpee test	.277	440-yard run	.249	Brace test	.316	Drop-off	.046	G.M.C.	.340	St. brd. jp.	.106
Power II	.128	60-yard dash	.258	60-yard dash	.249	G.M.C.	.276	Brace test	.041	Vert. jp.	.294	Height	.067
Weight	.063	Dips	.186	Chins	.248	Burpee test	.248	Age	.018	Burpee test	.235	G.M.Q.	.061
60-yard dash	.039	Vert. jp.	.184	Dips	.235	Drop-off	.246	Vert. jp.	.012	Brace test	.186	Age	.053
Vert. jp.	.037	Age	.173	Age	.188	Two-mile walk	.195	440-yard run	.003	Age	.131	Vert. jp.	.048
C.I.	.018	Two-mile walk	.122	Drop-off	.133	Age	.179	60-yard dash	.002	Weight	.112	G.M.C.	.048
Two-mile walk	-.026	Drop-off	.107	Two-mile walk	.063	C.I.	-.170	L.D.S.	-.015	Height	.077	C.I.	-.045
440-yard run	-.034	Weight	-.012	Weight	-.007	Weight	-.239	Burpee test	-.025	Two-mile walk	.040	Weight	-.047
Height	-.039	Height	-.029	C.I.	-.025	Height	-.402	Dips	-.156	C.I.	-.159	Dips	-.162
Drop-off	-.053	C.I.	-.041	Height	-.041	60-yard dash	-.723	Chins	-.170	Drop-off	-.162	60-yard dash	-.215

440-yard run		G.M.C.		G.M.Q.		Height		L.D.S.		Power I		Power II	
Drop-off	.601	Criterion	.791	St. brd. jp.	.902	C.I.	.674	Power I	.958	L.D.S.	.958	L.D.S.	.832
Criterion	.576	G.M.Q.	.719	Brace test	.734	Weight	.455	Power II	.832	Power II	.829	Criterion	.931
60-yard dash	.424	Vert. jp.	.650	G.M.C.	.719	G.M.C.	.414	Criterion	.797	Chins	.821	Power I	.829
L.D.S.	.457	Power II	.600	Vert. jp.	.681	Criterion	.254	Vert. jp.	.729	Dips	.783	Vert. jp.	.769
Power I	.422	L.D.S.	.562	L.D.S.	.673	Vert. jp.	.156	G.M.Q.	.673	Criterion	.768	G.M.Q.	.673
Power II	.420	St. brd. jp.	.546	Power II	.673	St. brd. jp.	.119	Chins	.673	Push-ups	.601	Chins	.666
Chins	.407	C.I.	.456	Power I	.577	Two-mile walk	.096	St. brd. jp.	.574	G.M.Q.	.577	Push-ups	.619
Two-mile walk	.368	Power I	.430	Burpee test	.515	440-yard run	.085	G.M.C.	.562	Vert. jp.	.527	G.M.C.	.600
G.M.Q.	.363	Height	.414	Dips	.427	Push-ups	.075	Dips	.550	G.M.C.	.430	Dips	.590
Vert. jp.	.366	Burpee test	.410	Push-ups	.424	Drop-off	.067	Push-ups	.424	440-yard run	.422	St. brd. jp.	.544
Dips	.360	Weight	.408	Chins	.421	Power I	.058	440-yard run	.457	60-yard dash	.413	60-yard dash	.447
Push-ups	.352	Push-ups	.369	60-yard dash	.407	Power II	.031	Brace test	.446	St. brd. jp.	.397	440-yard run	.420
St. brd. jp.	.318	Brace test	.365	440-yard run	.383	60-yard dash	.021	60-yard dash	.400	Brace test	.365	Brace test	.309
G.M.C.	.315	60-yard dash	.356	Age	.180	G.M.Q.	-.013	Burpee test	.288	Burpee test	.310	Burpee test	.289
Brace test	.300	Dips	.340	Two-mile walk	.104	L.D.S.	-.013	Age	.150	Drop-off	.249	Drop-off	.227
Burpee test	.249	Chins	.276	Criterion	.088	Brace test	-.029	Two-mile walk	.143	Two-mile walk	.214	Two-mile walk	.224
Height	.085	Age	.135	Drop-off	.061	Age	-.039	Drop-off	.138	Age	.155	Age	.128
Weight	.041	Two-mile walk	.128	Height	-.015	Burpee test	-.041	Height	-.013	C.I.	.108	C.I.	.053
C.I.	.003	Drop-off	.048	Weight	-.077	Dips	-.077	C.I.	-.015	Height	.058	Height	.031
Age	-.034	440-yard run	-.315	C.I.	-.084	Chins	-.402	Weight	-.080	Weight	-.102	Weight	-.581

Push-ups		60-yard dash		Standing broad jump		Two-mile walk		Vertical jump		Weight		Criterion	
Power II	.618	440-yard run	.484	G.M.Q.	.902	440-yard run	.388	Power II	.769	C.I.	.756	Power II	.831
Power I	.601	Power II	.447	Criterion	.719	60-yard dash	.367	L.D.S.	.729	Height	.455	L.D.S.	.797
Chins	.588	Criterion	.440	Vert. jp.	.589	Criterion	.280	Criterion	.713	G.M.C.	.408	G.M.C.	.791
Dips	.577	Power I	.413	L.D.S.	.574	Drop-off	.271	G.M.Q.	.681	Criterion	.258	Power I	.768
Criterion	.574	G.M.Q.	.407	G.M.C.	.548	Power II	.224	G.M.C.	.650	Vert. jp.	.079	Vert. jp.	.715
L.D.S.	.497	L.D.S.	.400	Power II	.544	Power I	.219	St. brd. jp.	.589	Age	.063	St. brd. jp.	.712
G.M.Q.	.424	Vert. jp.	.397	Brace test	.473	Push-ups	.218	Power I	.527	St. brd. jp.	.029	Brace test	.539
St. brd. jp.	.405	Dips	.367	Chins	.416	Chins	.195	60-yard dash	.388	60-yard dash	.087	Chins	.597
G.M.C.	.369	Two-mile walk	.357	Push-ups	.405	L.D.S.	.143	440-yard run	.366	Two-mile walk	.009	Dips	.592
Vert. jp.	.354	G.M.C.	.356	Power I	.397	Vert. jp.	.135	Push-ups	.354	Burpee test	-.007	440-yard run	.576
440-yard run	.352	Push-ups	.324	Dips	.343	St. brd. jp.	.134	Chins	.328	Brace test	-.012	Push-ups	.574
Brace test	.337	St. brd. jp.	.291	440-yard run	.318	G.M.C.	.128	Dips	.294	440-yard run	-.041	Burpee test	.440
60-yard dash	.324	Brace test	.258	60-yard dash	.291	Brace test	.122	Burpee test	.272	Drop-off	-.047	60-yard dash	.440
Burpee test	.261	Burpee test	.249	Burpee test	.274	G.M.Q.	.104	Brace test	.184	Push-ups	-.062	Two-mile walk	.280
Drop-off	.221	Age	.039	Age	.167	Height	.096	Height	.156	G.M.Q.	-.077	Height	.264
Two-mile walk	.216	Weight	.027	Two-mile walk	.134	Burpee test	.063	Two-mile walk	.135	L.D.S.	-.080	C.I.	.264
Age	.140	Height	.021	Height	.119	C.I.	.058	Weight	.073	Power I	-.102	Weight	.236
C.I.	-.057	C.I.	.008	Drop-off	.106	Dips	.040	Drop-off	.048	Dips	-.112	Age	.231
Weight	-.068	Drop-off	-.215	C.I.	.092	Weight	.009	Age	.027	Chins	-.239	Drop-off	.230
Height	-.075	Chins	-.725	Weight	.089	Age	-.026	C.I.	.012	Power II	-.551	G.M.Q.	.080

With such a reduction in the size of the criterion, it is essential that any spurious relationships be avoided. Accordingly, Larson's Dynamic Strength Test, Power I, and I.U. Motor Fitness Index I should be excluded from the criterion since each of these measures is quite similar in nature and would naturally reflect the spurious relationship which occurs when a test is included in its own criterion battery.

The items considered for inclusion in the criterion will be further analyzed by means of their ranked arrays of intercorrelations under each item (see Table I). Only non-spurious correlations will be considered as a rule.

The following items place the criterion high, and significantly so, in their ranked intercorrelations in the earlier study of motor fitness: Brace test, Burpee test, dips, 440-yard run, General Motor Capacity, Larson's Dynamic Strength Test, Power I, Power II, push-ups, 60-yard dash, standing broad jump, and vertical jump. With the exception of those previously indicated, these items merit consideration for inclusion in the criterion for this study. The following items either place the criterion low in their ranked intercorrelations or are insignificantly related to the criterion: age, Classification Index I, drop-off, General Motor Quotient, height, two-mile walk, and weight. They should therefore not be given consideration for inclusion in the criterion for this study, with the exception of the two-mile walk. This, it appears, should be retained since its highest correlations are with the three endurance measures and the criterion and also because there would be but one measure of endurance in the criterion if the walk is omitted.

The item-by-item analysis by means of these ranked intercorrelations follows. In this analysis especial emphasis is given to the factors with which these items are most and least related, and to the degree of such relationship.

Brace test (Iowa revision) ranks highest in its array with factors which are general in nature and which are of a general motor ability or fitness type. It is lowest with structural and endurance items.

Burpee test ranks less high but in practically the same manner as does the Brace test. That it does *not* measure the same ability as does the Brace test is evidenced by their low intercorrelation of .277.

Chins rank highest with all of the strength measures in its array. Their high negative correlation (—.723) with the 60-yard dash indicates that they are definitely inversely related to the speed form of velocity measure. They are inversely related to structure and correlate low with endurance measures.

Dips rank highest with all strength items and lowest with endurance and structure measures.

The 440-yard run ranks highest with the dash and general strength measures and next highest with the two-mile walk. It would seem that the run involves a systemic condition permitting of endurance. It is not motor ability since the motor ability items cluster in the low group of correlations. The correlations of structure and maturity items with this 440-yard run are *all* low to negative.

General Motor Capacity correlates quite high with the criterion

(.791) and ranks next highest with general power measures (strength and velocity). That it does not involve endurance is indicated by its three lowest to negative correlations with the two-mile walk, drop-off, and 440-yard run (.128, .048, and —.315 respectively).

Larson's Dynamic Strength Test and Power I warrant inclusion on the basis of their high correlations with general and strength measures. However, their inclusion would cause a spurious relationship with I.U. Motor Fitness Index I because of marked similarity to it, and this would distort findings and bring about undue validity to the latter measure about which this study centers. In view of this and the fact that they were excelled by the I.U. Motor Fitness Index II in the previous study, these two items should not be included in the criterion for this study.

Push-ups are undoubtedly of high relationship to all strength measures. They have low to low negative relationship to structure and maturity measures.

The 60-yard dash ranks highest with a velocity and endurance measure (440-yard run) but ranks practically as high with general strength measures. Since the dash also ranks quite low with structure and maturity factors, it seems to be related to the endurance element in the 440-yard run. It is definitely inversely related to chinning strength. It might be considered to reflect a general systemic condition therefore.

Standing broad jump is apparently a general measure related to velocity of the explosive or power type as opposed to the speed-over-a-period-of-time type. This is borne out by the low placement of endurance and speed-over-a-period-of-time measures in the standing broad jump array and the fact that its third highest correlation is with vertical jump. Structure and maturity measures are all quite low in this array.

Two-mile walk is highest with the 440-yard run and 60-yard dash. It is third highest (.280) with the criterion and similarly related to the drop-off. Its lowest relationships are with structural and maturity factors.

Vertical jump is quite similar in its behavior to the standing broad jump but the correlation between the two is only .589. Vertical jump seems to have slightly higher correlations in its array and with the criterion. Practically the same items rank high and low respectively in both measures.

From this analysis it would seem that the items indicated for inclusion in the present criterion for the validity of the test of motor fitness are those listed in Table II. The factors to which these items are most and least related are indicated.

A summary of Table II with respect to the four essential factors reveals that the selected criterion should be representative of physical education performance since each essential factor is measured by three or more items, for example:

Strength is measured by chins, dips, General Motor Capacity, push-ups, and straddle chins.

Velocity is measured by General Motor Capacity, 440-yard run, 60-yard dash, standing broad jump, and vertical jump.
Motor ability is measured by Brace test, Burpee test, and General Motor Capacity.
Endurance is measured by 440-yard run, 60-yard dash, and two-mile walk.

TABLE II. ELEMENTS SELECTED FOR THE CRITERION FOR THE PRESENT STUDY

Element	Factors indicated	Factors contra-indicated	*r* with criterion in original study
1. Brace test	Motor ability	Structure, endurance	.639
2. Burpee test	Motor ability	Structure, endurance	.440
3. Chins	Strength (arms)	Structure, endurance	.597
4. Dips	Strength (arms)	Structure, endurance	.592
5. 440-yard run	Endurance, velocity	Structure, maturity	.576
6. G.M.C.	General strength, motor ability, velocity	Endurance, speed	.791
7. Push-ups	Strength (arms)	Structure, maturity	.574
8. 60-yard dash	Velocity (speed), endurance	Strength (arms)	.440
9. Standing broad jump	Velocity	Endurance, speed, structure, maturity	.712
10. Two-mile walk	Endurance	Structure, maturity	.280
11. Vertical jump	Velocity	Endurance, speed, structure, maturity	.715
12. Straddle chins	Strength (arms)	An experimental measure unvalidated in any previous study. Presumably comparable with item 3.	

This table also shows that the elimination of structure and maturity items from the criterion in the previous study is quite justifiable.

Comparison of the correlations of the various motor fitness formulae with the criterion.—By employing the battery of 12 events given in Table II, a criterion score (sum of modified T-scores on all items) has been obtained from approximately 500 Indiana University male students measured in September, 1942. No cases are included in which more than one of the 12 items are missing. In the few cases lacking one item, the criterion score has been obtained by multiplying the average score on 11 items by 12. No cases are employed in which any item required in the formulae in Table III was lacking.

The comparison of the validities of the four proposed formulae, when the sum of the 12 items (modified T-scored) is the criterion of motor fitness, is made in Table III.

From this table it can be seen that *each* proposed formula provides high validity by the standards for this study. The I.U. Motor Fitness Index is the statistically preferred measure. The fact that it has a slightly higher correlation in this study than was obtained

in the initial study of this index may be due largely to the improved criterion measure in the present study. The high validity of all four of these measures would seem to be further proof of the soundness of the power principle (force times velocity) upon which these measures are based.

TABLE III. VALIDITY OF PROPOSED MOTOR FITNESS FORMULAE*

Motor Fitness Index	r with criterion	η_{xy}	Linear	Per cent related	Formulae	Cases
I.	.842 ± .01	.859	No	46.1	(C. + P.U.) x V.J.	488
II.	.818 ± .01	.828	Yes	42.5	(C. + P.U.) x S.B.J.	484
III.	.827 ± .01	.841	No	44.0	(S.C. + P.U.) x V.J.	488
IV.	.812 ± .01	.819	Yes	41.7	(S.C. + P.U.) x S.B.J.	482

* These validities are slightly spurious since the test items are also criterion items. The usefulness of all test items as activities justifies this spurious relationship, however.

It can further be noted in Table III that the use of straddle or partner chinning as a substitute for chinning on the bar is justified. The loss of only 2.1 per cent relationship is more than offset by the extreme gains in administrative simplicity of straddle chinning. Straddle chinning, however, correlates but .443 with the present criterion and but .282 with chins on the high bar. Although its validity in the criterion is acceptable, the chief justification of straddle chinning in the modified Motor Fitness Index is the fact that this index is a valid measure of the criterion and is administratively simpler than the original I.U. Motor Fitness Index. It appears that the modified Motor Fitness Index (No. III) is the preferred measure in situations where a high bar is not available or in which large numbers of persons (60 to 100 or more) must be handled in a short time. This formula (straddle-chins-plus-push-ups times vertical jump —all items T-scored) will be titled the I.U. Motor Fitness Index III hereafter.

With regard to the utilization of the standing broad jump in the place of the vertical jump, it can be seen that there is a loss in relationship of but 3.6 per cent and 4.4 per cent, respectively, when formulae II and IV are compared with I (I.U. Motor Fitness Index). If one considers the desirability of mats or pits for the standing broad jump, one will note little gain over the simple vertical jump technique which can be done against a wall, although a plywood jump board is preferable.

In order to compare the validities of present proposed formulae with the validities of other previously accepted tests in the field, a random selection of tests has been made and their validities are compared in Table IV.

From Table IV it can be seen that the validity coefficients of all four I.U. Motor Fitness Indices compare favorably with those of all observed tests with non-spurious criteria or non-judgment criteria. The usual low reliability of judgments makes these high validities

TABLE IV. COMPARISON OF THE VALIDITY COEFFICIENTS AND CRITERIA OF COMMONLY KNOWN TESTS OF PHYSICAL ABILITY AND THOSE OF I.U. MOTOR FITNESS INDICES

Description of test	r	Criterion	Description of test	r	Criterion
Garfiel	.794	Judgments	McCurdy (P.C.I.)*	.85	Cozens (G.A.A.)
Rogers (S.I.)* ..	.81	1 events	(16-year-olds)..	.639	Cozens (G.A.A.)
	.90	Estimates	Force Index	.83	Cozens (G.A.A.)
Brace (M.A.) ..	.58	Judgments	Graybeal	.913	17 events†
	.80	10 events	Humiston	.92	15 events†
Cozens (G.A.A.)	.97	41 events†	(unit scored) ..	.81	15 events
	.93	Judgments	Larson	.68	15 items
Johnson	.69	Not given		.79	(wf. I.U. criterion)†
McCloy (C.I.) ..	.737	5 events	I.U. Motor Fitness Index I ...	.859	12 events†
Alden, Horton, and Caldwell ..	.50-.60	Judgments		.831	20 events†‡
	.62	Term grades	I.U. Motor Fitness Index III .	.841	12 events†
	Low	Sports	I.U. Motor Fitness Index II ..	.818	12 events†
	.72	Swimming	I.U. Motor Fitness Index IV .	.812	12 events†

* S.I. = Strength Index; M.A. = Motor Ability Test; G.A.A. = General Athletic Ability Test; C.I. = Classification Index I; P.C.I. = Physical Capacity Index.

† These criteria included the test items. Hence validity is spurious.

‡ Obtained by present author in a previous study.

with judgments subject to some concern. It would seem that either the correlations were obtained in course rank groupings or the judges were aware of test results in making their comparisons.

Consideration of the extreme simplicity of the I.U. Motor Fitness Indices reveals that at last a simple classifier or achievement test of reasonably high validity has been found.

Summary.—It was proposed that the use of straddle or partner chinning in the I.U. Motor Fitness Index be validated.

The present criterion for Motor Fitness consists of (1) Brace test (Iowa revision), (2) Burpee test (10 seconds), (3) chins, (4) dips, (5) 440-yard run, (6) General Motor Capacity, (7) push-ups, (8) 60-yard dash, (9) standing broad jump, (10) two-mile walk, (11) vertical jump, (12) straddle chins. These items reflect the factors of strength, velocity, motor ability, and endurance, which are all fundamental to motor fitness.

All four proposed formulae have high validity (.859 to .812) as measures of motor fitness. This seems to corroborate the power prin-

ciple (force times velocity = power) upon which these measures have been based. I.U. Motor Fitness Index I is the preferred measure of motor fitness in this study as well as in the former one. It has validity coefficients of $r = .842 \pm .01$ and $\eta xy = .859 \pm .01$ which are high by standards for this study. This is the second study to reveal a validity of this size for I.U. Motor Fitness Index I.

Straddle or partner chinning, when substituted for chinning on the bar as used in I.U. Motor Fitness Index I, produces a modified Motor Fitness Index (No. III) the validity coefficients of which are $r = .827 \pm .01$ and $\eta xy = .841 \pm .01$. These coefficients are high when compared with those of I.U. Motor Fitness Index I and with the standards for this study.

The four Indiana University Motor Fitness Indices are all simple tests with favorably high validities.

EXPERIMENT FOR THE IMPROVEMENT OF ADMINISTRATIVE ABILITY-GROUPING OF COLLEGE MEN FOR PHYSICAL EDUCATION ACTIVITIES

For this study administrative ability grouping may be defined as the grouping of pupils according to ability by sectioning a school population of one sex into two or more groups relatively homogeneous with regard to a primary contributing factor and redividing each of the groups so formed into two or more sub-groups relatively homogeneous with regard to a secondary contributing factor. The hypothesis back of such grouping is that, by sectioning by one factor at a time, a homogeneity is obtained in each section with regard to each factor which is not possible if the factors are statistically combined and groups formed on the basis of such combined scores.

In explanation of the "administrative grouping technique," suppose there were 480 pupils in a junior high school. If half of these pupils were boys and half were girls there would be 240 pupils in each of the two groups below.

Boys	Girls
240	240

Then if all the boys and girls were given a strength test such as I.U. Motor Fitness Index I, and the score cards of the boys and those of the girls were arranged in ascending order, the upper 33⅓ per cent (in strength) of the boys or of the girls could be counted off in each group, the next 33⅓ per cent in each group would be average in strength, and the lowest 33⅓ per cent in each group would constitute the lowest strength thirds of the boys and girls respectively. Thus the groups would each have been sectioned according to their strength (as measured by I.U. Motor Fitness Index I) and there would be approximately 80 pupils in each section as indicated below.

Boys			Girls		
Weak	Average	Strong	Weak	Average	Strong
80	80	80	80	80	80

If it is found desirable that the structure of these children be considered as well as their function, each boy and girl can then be scored on his McCloy's Classification Index I (the best combination of age, height, and weight). If the score cards are then arranged in ascending order within the respective strength groups, the highest half of the Classification Index scores can be counted in each of the above six groups and the group thus be divided by structure. There are then two groups of approximately 40 pupils each sectioned out of each of the six groups of 80. The final grouping may be as diagrammed below:

Boys		
Weak	Average	Strong
Large 40	Large 40	Large 40
Small 40	Small 40	Small 40

Girls		
Weak	Average	Strong
Large 40	Large 40	Large 40
Small 40	Small 40	Small 40

If to these 12 groups of children a battery of measures of physical education performance is given as a criterion measure and it is found that there are significantly different abilities on the average for each group, an ability grouping for physical education classes would be established *administratively* (as opposed to statistically) that would be composed of 12 groups homogeneous for sex and relatively homogeneous for strength and for physique. The result of such grouping should be more effective teaching, greater safety in competitive sports, greater incentive to fullest participation and performance, possibility of subject matter being better suited to pupil interests, needs, and capacities, and more just and adequate evaluation of individual and group performances.

The feasibility of such administrative ability grouping technique was first statistically established by this author in a study of elementary, junior high, senior high, junior college, and college subjects.[4] It was again validated for junior high school girls by Ketchum,[5] who employed Humiston's Motor Ability Test as the primary classifier and C.I.F. (California Interscholastic Federation Index) as the secondary measure of hulk and maturity. Recently[6] the present author has cooperated in a simplified procedure employing Larson's Dynamic Strength Test as the primary classifier. The extremely satisfying results of this simple procedure, requiring only age, height, weight, chins, dips, and vertical jump, prompted the present effort to simplify the procedure further by substituting T-scored items for

[4] Bookwalter, Karl W., "A Critical Evaluation of Some of the Existing Means for Classifying Boys for Physical Education," *Research Quarterly* 10:119-127, October, 1939.

[5] Ketchum, Marjory W., "A Homogeneous Grouping of Junior High School Girls for Physical Education." *The Physical Educator* 3:31-34, October, 1942.

[6] Bookwalter, Karl W.; Ballin, Ralph; and Bookwalter, Carolyn W., "A Simple Valid Administrative Grouping of High School Boys," *Research Quarterly* 13:512-519, December, 1942.

weighted items and mass administered tests for individual or squad procedures where possible.

Such authors of physical education tests as Brace[7] in his Motor Ability Test and McCloy[8] in his Classification Index recommend that their measures be employed in connection with other measures, especially strength measures. Rogers[9] has warned that a composite score of several unlike measures tends to destroy homogeneity in those traits rather than to provide it. He further states that "one thing at a time" should be the rule in dividing pupils into homogeneous groups. Such statements as these, and the observation of marked structural deviations among pupils presumably classified homogeneously by such measures as P.F.I. (Physical Fitness Index), have led the present author to search for simple but appropriate measures and procedures to supply the obvious need for better classification of pupils for physical education classes.

Criteria for administrative ability grouping.—In the author's previous studies of administrative ability grouping, the following criteria have been found to be discriminative of the superior combinations from among many proposed administrative combinations. Their practical success in these other studies indicates that they should again be utilized in the evaluation of administrative ability groupings in the present experiment.

These criteria,[10] in approximate order of importance, are:

1. *Degree of correlation of classifier with criterion scores.* A classifier should have a high degree of relationship to the traits which it presumes to classify. This will be indicated by the correlation of the classifiers with the criterion.

2. *Regularity of increment in averages of criterion scores in successive ability groups.* If, by reason of their rank in the classifiers, groups are rated from superior to inferior successively, their performances in the criterion should reflect these same abilities in the same order.

3. *Significant critical ratios.* Critical ratios of differences between successive or adjacent means should equal or exceed 2.5 to be significant.

4. *Average of critical ratios.* The critical ratios of two or more proposed administrative groupings may all equal 2.5 or more but, other things being equal, the grouping having the highest average of critical ratios is the preferred one.

5. *Average difference between criterion averages.* The greater the differences in abilities between successive groups, the more homogeneous such groups will be.

6. *Ease of administration.* Other things being equal, the simpler

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[7] Brace, David K., *Measuring Motor Ability*, A. S. Barnes and Co., New York, 1927. p. 91.

[8] McCloy, Charles H., *Measuring Athletic Power*, A. S. Barnes and Co., New York, 1932. p. 100.

[9] Rogers, Frederick Rand, *Tests and Measurement Programs in the Redirection of Physical Education*, School Administration Series, Bureau of Publications, Teachers College, Columbia University, New York, 1927. p. 63.

[10] Bookwalter, Karl W.; Ballin, Ralph; and Bookwalter, Carolyn W., *op. cit.*, p. 512.

the classifiers the better. Simplicity is determined by the number and nature of the items involved.

7. *Classifiers that account for strength, velocity, motor ability, endurance, dead weight, and height.* The greater the number of these factors accounted for by the classifiers and the more completely they are accounted for, the more likely are the classifiers to provide ability sectioning.

8. *Average coefficient of variation.* The coefficient of variation is an index of the variability of the group. The smaller the average coefficient of variation, the greater the homogeneity set up by the administrative grouping.

9. *Correlation of classifiers with each other.* The classifiers should be as disparate as possible, hence their correlations should be as small as possible.

The criterion of physical ability.—All previous studies validating the administrative ability grouping technique have utilized the above criteria of discrimination and have also employed as a criterion of performance a battery of seven varied individual athletic events modified T-scored. If former results are to be even crudely compared, it is necessary that the present criterion scores should have means potentially comparable in size to the means of previous studies. It is further desirable that the criterion be as varied and as complete a sampling of the total achievements as possible. It is therefore proposed that the following seven measures be summed for the criterion of physical ability in this study of the merits of the several Motor Fitness Indices as functional and primary classifiers: (1) chins, (2) dips, (3) standing broad jump, (4) 60-yard dash, (5) 440-yard run, (6) Brace test, and (7) Burpee test. These seven measures represent the four factors of strength, velocity, endurance, and motor ability. Each factor is reflected by two measures, with the exception of endurance, which is represented by 440-yard run only. These seven items were included in the 12-item criterion employed in the first part of this study.

Combinations 9 and 10 in Table V are taken from a previous study of administrative grouping of college men.[11] These combinations are the two preferred from a list of ten or more such groupings applied to college men. In this table the following facts are revealed:

1. The correlations of Motor Fitness Indices I, II, III, and IV with their common criterion are greater than are the correlations of Force Index or Strength Index with a similar criterion in the previous study (.859 to .812 as compared with .639 and .587 for the two strength classifiers respectively).

2. The use of I.U. Motor Fitness Indices as primary classifiers is preferred to that of Classification Index I. This is shown by the negative correlation (—.130) existing between the criterion and Classification Index I. When the functional measures (Motor Fitness Indices) are the primary classifiers, it is necessary to use Classification

[11] Bookwalter, Karl W., "A Critical Evaluation of Some of the Existing Means of Classifying Boys for Physical Education," *Research Quarterly* 10:119-127, October, 1939.

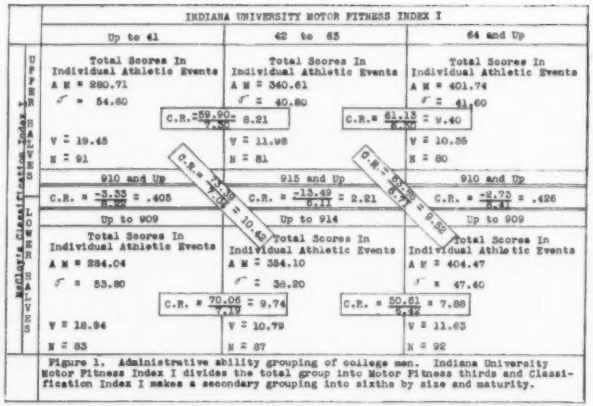
INDIANA UNIVERSITY MOTOR FITNESS INDEX I
McCloy's Classification Index I
UPPER HALVES
LOWER HALVES
Up to 41
42 to 63
64 and Up
Total Scores In Individual Athletic Events
A M = 280.71
σ = 54.60
V = 19.45
N = 91
A M = 340.61
σ = 40.80
V = 11.98
N = 81
A M = 401.74
σ = 41.60
V = 10.35
N = 80
C.R. = 59.90 / 7.26 = 8.21
C.R. = 61.13 / 6.47 = 9.40
910 and Up
915 and Up
910 and Up
C.R. = -3.35 / 8.62 = .405
C.R. = 13.49 / 5.11 = 2.21
C.R. = -2.75 / 6.47 = .426
Up to 909
Up to 914
Up to 909
A M = 284.04
σ = 53.80
V = 18.94
N = 83
A M = 354.10
σ = 38.20
V = 10.79
N = 87
A M = 404.47
σ = 47.40
V = 11.65
N = 92
C.R. = 70.06 / 7.19 = 9.74
C.R. = 50.61 / 6.42 = 7.88
C.R. = 74.78 / 7.26 = 10.42
C.R. = 57.26 / 6.47 = 8.92

Figure 1. Administrative ability grouping of college men. Indiana University Motor Fitness Index I divides the total group into Motor Fitness thirds and Classification Index I makes a secondary grouping into sixths by size and maturity.

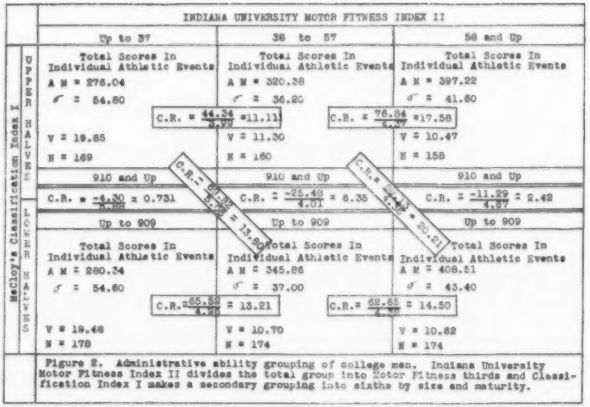

Figure 2. Administrative ability grouping of college men. Indiana University Motor Fitness Index II divides the total group into Motor Fitness thirds and Classification Index I makes a secondary grouping into sixths by size and maturity.

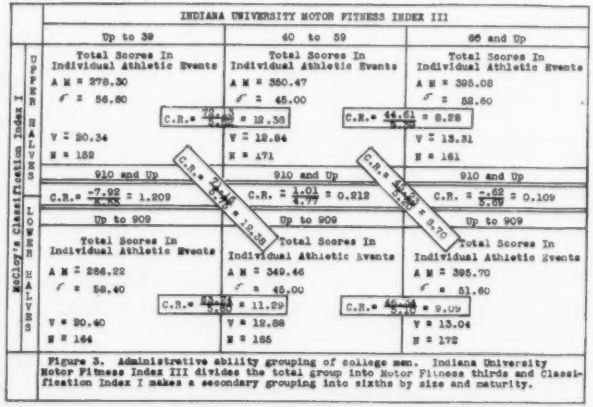

Figure 3. Administrative ability grouping of college men. Indiana University Motor Fitness Index III divides the total group into Motor Fitness thirds and Classification Index I makes a secondary grouping into sixths by size and maturity.

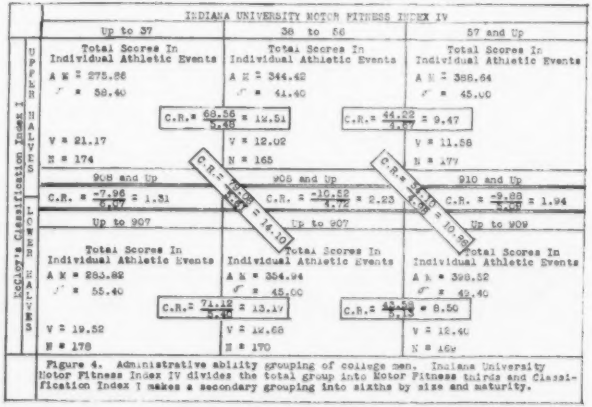

Figure 4. Administrative ability grouping of college men. Indiana University Motor Fitness Index IV divides the total group into Motor Fitness thirds and Classification Index I makes a secondary grouping into sixths by size and maturity.

TABLE V. EVALUATION, ACCORDING TO SELECTED CRITERIA, OF ADMINISTRATIVE GROUPINGS OF COLLEGE MEN

Combination of classifiers*		Criteria									
		r with criterion		Regularity of increment	Number of critical ratios below 2.5	Average critical ratio	Average difference in criterion averages	Administrative difficulty of items	Accounts for S V M E W H†	Average variation	r with each other
Primary	Secondary	Primary classifiers	Secondary classifiers								
1 M_1	C.I.	.859	—.130	3 overlap	3	6.47	44.27	6	• • • • •	13.86	—.014
2 C.I.	M_1	—.130	.859	5 overlap	2‡	8.9	59.00	6	• • • • •	14.71	
3 M_2	C.I.	.818	—.130	3 overlap	2	11.10	49.82	6	• • • • •	13.74	—.076
4 C.I.	M_2	—.130	.818	4 overlap	2	10.09	55.24	6	• • • • •	15.31	
5 M_3	C.I.	.827	—.130	2 overlap	3	6.24	41.37	6	• • • • •	15.47	—.008
6 C.I.	M_3	—.130	.827	5 overlap	3	6.56	54.40	6	• • • • •	16.22	
7 M_4	C.I.	.812	—.130	3 overlap	3	8.23	43.22	6	• • • • •	14.90	—.039
8 C.I.	M_4	—.130	.812	6 overlap	3	8.78	50.94	6	• • • • •	15.84	
9 F.I.	S.I.	.639	.587	All reg.	3	3.37	52.85	12	• • •	28.19	.769
10 S.I.	F.I.	.587	.639	All reg.	3	2.94	60.14	12	• • •	26.10	

* C.I. = Classification Index I; M_1 = Motor Fitness Index I (chins-plus-push-ups times vertical jump); M_2 = Motor Fitness Index II (chins-plus-push-ups times standing broad jump); M_3 = Motor Fitness Index III (straddle-chins-plus-push-ups times vertical jump); M_4 = Motor Fitness Index IV (straddle-chins-plus-push-ups times standing broad jump); F.I. = Force Index; S.I. = Strength Index.

† S = strength; V = velocity; M = motor ability; E = endurance; W = weight; H = height.

‡ Irregularity was insignificant.

Index I in inverse order (the lower C.I. scores in the upper criterion ability groups) to obtain a regular progression in the mean criterion performances in successive groups. (There are three such combinations, Motor Fitness Indices I, II, and IV, giving a regular progression.) Successive or adjacent ability groups overlap in from four to six places when Classification Index is the primary classifier.

3. There are from two to three critical ratios below 2.5 in all combinations under consideration. However, Motor Fitness Index II, with any of the three combinations with Classification Index I, produces less overlapping of groups than do any of the other Motor Fitness Indices.

4. The highest averages of critical ratios are obtained when Motor Fitness Index II is employed. The next highest averages of critical ratios are obtained when Motor Fitness Index IV is employed. None of the averages of critical ratios is less than 5.95 and some averages are as high as 11.10.

Thus it can be seen that all Motor Fitness Indices provide two or more times the average critical ratio that the previously recommended strength tests produce.

5. The average criterion differences when Strength Index and Force Index are used as classifiers are as a rule higher than those obtained when Motor Fitness Indices are employed with Classification Index I as classifiers. In each of the latter instances the highest average criterion difference occurs when Classification Index I is the primary classifier. The better criterion averages produced when a Motor Fitness Index is the primary classifier occur with Motor Fitness Index II.

6. In all instances the combinations proposed in this study are materially simpler than the previously recommended strength tests. There are but six items (age, height, weight, a chin, a push-up, and a jump) to be obtained in the Motor Fitness Indices as compared with 12 measures to be obtained in the strength test combinations. In addition, the latter test items are more expensive to administer.

7. The proposed I.U. Motor Fitness Index combinations with Classification Index I account for strength, velocity, motor ability, weight, height, and maturity, whereas the two strength tests account for strength, weight, and height only.

8. The homogeneity of the groups classified by Motor Fitness Indices is approximately twice that obtained by the strength tests when the coefficient of variation is the criterion of this quality. The greatest homogeneity is again obtained when Motor Fitness Index II is the primary classifier. Motor Fitness Index I is approximately as good in this respect.

9. The intercorrelations of Motor Fitness Indices and Classification Index I are markedly and desirably smaller than is the intercorrelation of the two strength tests; in fact the former correlations are slightly negative (—.008 to —.076 as compared to .769 for the strength tests).

In summary it would appear from these criteria that the use of Motor Fitness Indices as primary classifiers and Classification Index I

as the secondary classifier is the preferred procedure when all things are considered. Of these, Motor Fitness Index III (straddle-chins-plus-push-ups times vertical jump) is slightly inferior to the others and Motor Fitness Index II (chins-plus-push-ups times standing broad jump) is appreciably the superior combination. These differences might be waived in consideration of ease of administration. Accordingly, in the following section of this study achievement scales and norms will be set up for all four Motor Fitness Indices.

Scale scores for items used in computing any of these Motor Fitness Indices are in the appendix following this study, as are brief directions for their computation.

NORMS FOR I.U. MOTOR FITNESS INDICES

It is an established principle that education widens differences between people. An analysis[12] of several tests and measures variously recommended for classification of boys for physical education shows also that normal growth and development differentiates persons in their functional capacities. To assume a common norm in any physical performance for all men of college age is to neglect the facts.

Achievement scales in selected strength tests have been set up for secondary school boys and college men.[13] In these scales separate norms, with statistically reliable differences, have been set up for different age-height-weight groupings in secondary schools and for age-height-weight groupings and height-weight class divisions for college men. Since age, grade, height, and weight, when taken separately, have been shown repeatedly to have little correlation with physical performances, no attempt will be made to set up norms for these singly.

It is proposed to employ the same classification procedures and the same groupings in the present norming of I.U. Motor Fitness Indices as were employed in the achievement scales just mentioned. These classification procedures are McCloy's Classification Index I[14] and Cozens' Height-Weight Class divisions.[15] The first of these measures can be computed by any college student or noncommissioned officer from a table on page 119 of McCloy's study. The age, height, and weight of the student must be known. For the procedure by Cozens, only the height and weight of the student need be known and his classification can be determined from the table on page 9 of his book mentioned above.

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[12] Bookwalter, Karl W., "A Critical Evaluation of Some of the Existing Means of Classifying Boys for Physical Education," *Research Quarterly* 10:119-127, October, 1939.

[13] Bookwalter, Karl W., and Bookwalter, Carolyn W., "Achievement Scales in Strength Tests for Secondary School Boys and College Men," *The Physical Educator* 2:130-141, February, 1942.

[14] McCloy, Charles H., *Measuring Athletic Power*, A. S. Barnes and Co., New York, 1932, pp. 96, 97, 119.

[15] Cozens, Frederick W., *Achievement Scales in Physical Education Activities for College Men*, Lea and Febiger, Philadelphia, 1936, pp. 7-12.

USES FOR ACHIEVEMENT SCALES IN INDIANA UNIVERSITY MOTOR FITNESS INDICES

It is felt that there are many valid uses for these achievement scales in the I.U. Motor Fitness Indices.

To enable users of these Motor Fitness Indices to evaluate performances or to assign partial marks equitably upon scores in these tests, achievement scales have been set up for Classification Index I groupings of college men and Cozens' Height-Weight Class divisions. These scales have been set up on the basis of $\pm 3\sigma$ of the average, which is the basis employed in commonly utilized achievement scales by Cozens and other workers in the field. Scale scores in all Motor Fitness Indices may accordingly be added to scale scores obtained in other college achievement scales for men.

Comparable scales for Force Index, Larson's Dynamic Strength Test, Physical Capacity Index, Physical Fitness Index, and Strength Index may be found in "Achievement Scales in Strength Tests for Secondary School Boys and College Men.[16] These scales and those for Motor Fitness Indices I, II, III, and IV, on pages 23-38 can be used as norms for survey purposes, as standards to motivate accomplishment in physical fitness programs, as a partial measure for final marks, as one criterion for prospective teachers of physical education, as a partial measure of program effectiveness, and as a basis for further research in which comparisons are necessary.

Table VI shows the number of cases involved in the several scales and the class intervals into which the Classification Index I (McCloy) was broken. These intervals are comparable to those employed in the scales cited just above.

TABLE VI. FREQUENCIES INVOLVED IN CLASSIFICATION INDEX I GROUPS FOR I.U. MOTOR FITNESS INDICES I, II, III, AND IV

Motor Fitness Index	Classification Index groups						
	Up to 849	850 to 874	875 to 899	900 to 924	925 to 949	950 to 974	975 and up
I.	35	153	549	632	448	136	36
II.	35	153	518	664	445	136	34
III.	35	163	500	585	425	141	36
IV.	35	153	500	635	423	145	34

TABLE VII. FREQUENCIES INVOLVED IN COZENS' HEIGHT-WEIGHT CLASS DIVISIONS FOR THE I.U. MOTOR FITNESS INDICES I, II, III, AND IV

Motor Fitness Index	Height-Weight Class divisions								
	SS*	SM	SH	MS	MM	MH	TS	TM	TH
I.	18	92	79	91	532	409	77	368	324
II.	19	94	93	90	538	394	78	361	326
III.	18	98	73	88	510	396	70	355	322
IV.	18	95	81	87	522	394	69	350	320

* SS = short slender; SM = short medium; SH = short heavy; MS = medium slender; MM = medium medium; MH = medium heavy; TS = tall slender; TM = tall medium; TH = tall heavy.

[16] Bookwalter, Karl W., and Bookwalter, Carolyn W., "Achievement Scales in Strength Tests for Secondary School Boys and College Men," *The Physical Educator* 2:179-190, April, 1942.

In Tables VI and VII it can be seen that approximately 2,000 cases are involved in each Motor Fitness Index and that, with the exception of the short slender Height-Weight Class division, the sampling is adequate. In other groups with small sampling the fact that the group is relatively homogeneous tends to give more reliability to the numbers than would otherwise be given.

Temporary standards of attainment in these scales can be obtained by the use of the standard deviation technique shown in Table VIII.

TABLE VIII. SCALE POINTS FOR ASSIGNING LETTER MARKS, AS DETERMINED BY TWO STANDARD DEVIATION TECHNIQUES

6 standard deviation range		Standard	5 standard deviation range	
Per cent of total cases	Point ranges		Point ranges	Per cent of total cases
3.5	81-100	A or superior	76-100	7
24	61-80	B or good	59-75	24
45	41-60	C or normal	42-58	38
24	21-40	D or poor	25-41	24
3.5	0-20	F or inferior	0-24	7

If the performances in a school do not conform reasonably closely to the above standards, then that school should ascertain the standard deviation for each classification group and set the following standard deviation values for the respective standards. Normal = $\pm.5\sigma$; good = over $+.5\sigma$ up to $+1.5\sigma$; superior = more than $+1.5\sigma$; poor = less than $-.5\sigma$ down to -1.5σ; and inferior = less than -1.5σ.

ACHIEVEMENT SCALES IN MOTOR FITNESS INDICES FOR COZENS' HEIGHT-WEIGHT CLASS DIVISIONS AND McCLOY'S CLASSIFICATION INDEX I GROUPINGS

Motor Fitness Index I
Height-Weight Class Divisions

Scale Score	SS	SM	SH	MS	MM	MH	TS	TM	TH
100	121	146	150	104	139	127	130	127	136
99	120	144	148	103	137	126	128	126	135
98	118	142	146	102	135	124	127	124	133
97	117	140	144	101	134	123	125	123	132
96	116	139	142	100	132	121	123	121	130
95	114	137	140	98	131	120	122	120	128
94	113	135	138	97	129	119	120	119	127
93	111	134	136	96	128	117	118	117	125
92	110	132	135	95	126	116	117	116	124
91	109	130	133	94	124	114	115	114	122
90	107	128	131	93	123	113	113	113	121
89	106	127	129	92	121	111	112	111	119
88	104	125	127	91	120	110	110	110	117
87	103	123	125	90	118	109	108	109	116
86	102	121	124	88	117	107	107	107	114
85	100	120	122	87	115	106	105	106	113
84	99	118	120	86	113	104	103	104	111
83	97	116	118	85	112	103	102	103	109
82	96	115	116	84	110	102	100	102	108
81	95	113	114	83	109	100	98	100	106
80	93	111	112	82	107	99	97	99	105
79	92	109	111	81	106	97	95	97	103
78	91	108	109	79	104	96	93	96	102
77	89	106	107	78	103	94	92	94	100
76	88	104	105	77	101	93	90	93	98
75	86	103	103	76	99	92	88	92	97
74	85	101	101	75	98	90	87	90	95
73	84	99	100	74	96	89	85	89	94
72	82	97	98	73	95	87	83	87	92
71	81	96	96	72	93	86	82	86	91
70	79	94	94	70	92	84	80	84	89
69	78	92	92	69	90	83	78	83	87
68	77	91	90	68	88	82	77	82	86
67	75	89	89	67	87	80	75	80	84
66	74	87	87	66	85	79	73	79	83
65	73	85	85	65	84	77	72	77	81
64	71	84	83	64	82	76	70	76	79
63	70	82	81	63	81	75	68	75	78
62	68	80	79	62	79	73	67	73	76
61	67	78	78	60	77	72	65	72	75
60	66	77	76	59	76	70	63	70	73
59	64	75	74	58	74	69	62	69	72
58	63	73	72	57	73	67	60	67	70
57	61	72	70	56	71	66	58	66	68
56	60	70	68	55	70	65	57	65	67
55	59	68	66	54	68	63	55	63	65
54	57	66	65	53	66	62	53	62	64
53	56	65	63	51	65	60	52	60	62
52	54	63	61	50	63	59	50	59	61
51	53	61	59	49	62	58	48	58	59
50	52	60	57	48	60	56	47	56	57
49	50	58	55	47	59	55	45	55	56
48	49	56	54	46	57	53	44	53	54
47	48	54	52	45	55	52	42	52	53
46	46	53	50	44	54	50	40	50	51
45	45	51	48	42	52	49	39	49	49
44	43	49	46	41	51	48	37	48	48
43	42	48	44	40	49	46	35	46	46
42	41	46	43	39	48	45	34	45	45
41	39	44	41	38	46	43	32	43	43

Motor Fitness Index I (continued)
Height-Weight Class Divisions

Scale Score	SS	SM	SH	MS	MM	MH	TS	TM	TH
40	38	42	39	37	44	42	30	42	42
39	36	41	37	36	43	40	29	40	40
38	35	39	35	35	41	39	27	39	38
37	34	37	33	34	40	38	25	38	37
36	32	35	32	32	38	36	24	36	35
35	31	34	30	31	37	35	22	35	34
34	29	32	28	30	35	33	20	33	32
33	28	30	26	29	33	32	19	32	30
32	27	29	24	28	32	31	17	31	29
31	25	27	22	27	30	29	15	29	27
30	24	25	20	26	29	28	14	28	26
29	22	23	19	25	27	26	12	26	24
28	21	22	17	23	26	25	10	25	23
27	20	20	15	22	24	23	9	23	21
26	18	18	13	21	22	22	7	22	19
25	17	17	11	20	21	21	5	21	18
24	16	15	9	19	19	19	4	19	16
23	14	13	8	18	18	18	2	18	15
22	13	11	6	17	16	16		16	13
21	11	10	4	16	15	15		15	12
20	10	8	2	14	13	13		13	10
19	9	6		13	11	12		12	8
18	7	5		12	10	11		11	7
17	6	3		11	8	9		9	5
16	4	1		10	7	8		8	4
15	3			9	5	6		6	2
14	2			8	4	5		5	1
13				7	2	4		3	
12				6	1	2		2	
11				4		1		1	
10				3					
9				2					
8				1					
7									
6									
5									
4									
3									
2									
1									

Motor Fitness Index II
Height-Weight Class Divisions

Scale Score	SS	SM	SH	MS	MM	MH	TS	TM	TH
100	91	135	130	106	120	122	123	116	120
99	90	133	129	105	118	121	121	115	118
98	89	131	127	104	117	119	120	113	117
97	88	130	126	102	115	118	118	112	116
96	87	128	124	101	114	116	117	111	114
95	86	126	122	100	113	115	115	109	113
94	85	125	121	98	111	113	114	108	111
93	84	123	119	97	110	112	112	106	110
92	83	122	118	96	108	111	111	105	108
91	82	120	116	94	107	109	110	104	107
90	81	118	114	93	105	108	108	102	105
89	80	117	113	92	104	106	106	101	104
88	79	115	111	91	102	105	105	100	102
87	77	113	110	89	101	103	103	98	101
86	76	112	108	88	99	102	102	97	99
85	75	110	107	87	98	100	100	96	98
84	74	109	105	85	96	99	99	94	97
83	73	107	103	84	95	98	98	93	95
82	72	105	102	83	93	96	96	92	94
81	71	104	100	81	92	95	95	90	92
80	70	102	99	80	90	93	93	89	91
79	69	100	97	79	89	92	92	87	89
78	68	99	95	78	88	90	90	86	88
77	67	97	94	76	86	89	89	85	86
76	66	95	92	75	85	87	87	83	85
75	65	94	91	74	83	86	86	82	83
74	64	92	89	72	82	84	84	81	82
73	63	91	88	71	80	83	83	79	81
72	62	89	86	70	79	82	81	78	79
71	61	87	84	68	77	80	80	77	78
70	60	86	83	67	76	79	78	75	76
69	59	84	81	66	74	77	77	74	75
68	58	82	80	65	73	76	75	73	73
67	57	81	78	63	71	74	74	71	72
66	56	79	77	62	70	73	72	70	70
65	55	78	74	61	68	71	71	68	69
64	54	76	73	59	67	70	69	67	67
63	53	74	72	58	65	69	68	66	66
62	52	73	70	57	64	67	66	64	64
61	51	71	69	55	63	66	65	63	63
60	50	69	67	54	61	64	63	62	62
59	49	68	65	53	60	63	62	60	60
58	48	66	64	52	58	61	60	59	59
57	47	65	62	50	57	60	59	58	57
56	46	63	61	49	55	58	57	56	56
55	45	61	59	48	54	57	56	55	55
54	44	60	58	46	52	55	54	53	53
53	43	58	56	45	51	54	53	52	51
52	42	56	54	44	49	53	51	51	50
51	41	55	53	42	48	51	50	49	48
50	40	53	51	41	46	50	48	48	47
49	39	51	50	40	45	49	47	47	45
48	38	50	48	39	43	48	45	45	44
47	37	48	47	37	42	45	44	44	43
46	36	47	45	36	41	44	42	43	41
45	35	45	43	35	38	42	41	41	40
44	34	43	42	33	36	40	38	39	38
43	33	42	40	32	35	39	37	38	37
42	32	40	39	31	34	38	36	37	35
41	31	38	37	29	33	37	35	36	34
40	30	37	35	28	32	35	33	34	32
39	29	35	34	27	30	34	32	33	31
38	28	34	32	26	29	32	30	32	29
37	26	32	31	24	27	31	29	30	28
36	25	30	29	23	26	29	27	29	26
35	24	29	28	22	24	28	26	28	25
34	23	27	26	20	23	26	25	26	24
33	22	25	24	19	21	25	23	25	22
32	21	24	23	18	20	24	22	24	21
31	20	22	21	16	18	22	20	22	19

Motor Fitness Index II (continued)
Height-Weight Class Divisions

Scale Score	SS	SM	SH	MS	MM	MH	TS	TM	TH
30	19	20	20	15	17	21	19	21	18
29	18	19	18	14	16	19	17	19	16
28	17	17	16	13	14	18	16	18	15
27	16	16	15	11	13	16	14	17	13
26	15	14	13	10	11	15	13	15	12
25	14	12	12	9	10	13	11	14	10
24	13	11	10	7	8	12	10	13	9
23	12	9	9	6	7	10	8	11	8
22	11	7	7	5	5	9	7	10	6
21	10	6	5	3	4	8	6	9	5
20	9	4	4	2	2	6	4	7	3
19	8	3	2	1	1	5	2	6	2
17	6					2		3	
18	7	1	1			3	1	5	
16	5							2	
15	4								
14	3								
13	2								
12	1								
11									
10									
9									
8									
7									
6									
5									
4									
3									
2									
1									

Motor Fitness Index III
Height-Weight Class Divisions

Scale Score	SS	SM	SH	MS	MM	MH	TS	TM	TH
100	119	138	145	129	142	145	122	132	138
99	117	136	143	128	140	143	121	131	137
98	116	135	141	126	139	141	119	129	135
97	115	133	139	125	137	140	118	128	134
96	113	131	138	124	136	138	117	126	132
95	112	130	136	122	135	136	115	125	130
94	110	128	134	121	133	135	114	123	129
93	109	127	132	120	132	133	112	122	127
92	108	125	131	118	130	131	111	120	125
91	106	123	129	117	129	129	109	119	124
90	105	122	127	116	127	128	108	117	122
89	103	120	125	114	126	126	106	116	121
88	102	119	124	113	125	124	105	114	119
87	101	117	122	112	123	123	103	113	117
86	99	115	120	110	122	121	102	111	116
85	98	114	118	109	120	119	100	110	114
84	96	112	117	107	119	117	99	108	113
83	95	110	115	106	117	116	97	107	111
82	94	109	113	105	116	114	96	105	109
81	92	107	111	103	115	112	94	104	108
80	91	106	110	102	113	110	93	102	106
79	89	104	108	101	112	109	91	101	104
78	88	102	106	99	110	107	90	99	103
77	87	101	104	98	109	105	88	98	101
76	85	99	103	97	107	104	87	96	100
75	84	97	101	95	106	102	85	95	98
74	82	96	99	94	105	100	84	93	96
73	81	94	97	93	103	98	83	92	95
72	80	93	96	91	102	97	81	90	93
71	78	91	94	90	100	95	80	89	91
70	77	89	92	89	99	93	78	87	90
69	75	88	90	87	97	92	77	86	88
68	74	86	89	86	96	90	75	84	87
67	73	84	87	85	95	88	74	83	85
66	71	83	85	83	93	86	72	81	83
65	70	81	83	82	92	85	71	80	82
64	68	80	82	81	90	83	69	78	80
63	67	78	80	79	89	81	68	77	78
62	66	76	78	78	87	80	66	75	77
61	64	75	76	77	86	78	65	74	75
60	63	73	75	75	85	76	63	72	74
59	61	72	73	74	83	74	62	71	72
58	60	70	71	73	82	73	60	69	70
57	59	68	69	71	80	71	59	67	69
56	57	67	68	70	79	69	57	66	67
55	56	65	65	69	77	67	56	65	66
54	54	63	64	67	76	66	54	63	64
53	53	62	62	66	75	64	53	62	62
52	52	60	61	65	73	62	51	60	61
51	50	59	59	63	72	61	50	59	59
50	49	57	57	62	70	59	48	57	57
49	48	55	55	61	69	57	47	56	56
48	46	54	54	59	67	55	45	54	54
47	45	52	52	58	66	54	44	53	53
46	43	50	50	57	65	52	43	51	51
45	42	49	48	55	63	50	41	50	49
44	40	47	47	54	61	49	40	48	48
43	39	46	45	53	60	47	38	47	46
42	38	44	43	51	59	45	37	45	44
41	36	42	41	50	57	43	35	44	43
40	35	41	40	49	56	42	34	42	41
39	34	39	38	47	55	40	32	41	40
38	32	38	36	46	53	38	31	39	38
37	31	36	34	45	52	36	29	38	36
36	29	34	33	43	50	35	28	36	35
35	28	33	31	42	49	33	26	35	33
34	26	31	29	40	47	31	25	33	32
33	25	29	27	39	46	30	23	32	30
32	24	28	26	38	45	28	22	30	28
31	23	26	24	36	43	26	20	29	27

Motor Fitness Index III (continued)
Height-Weight Class Divisions

Scale Score	SS	SM	SH	MS	MM	MH	TS	TM	TH
30	21	25	22	35	42	24	19	27	25
29	19	23	20	34	40	23	17	26	23
28	18	21	19	32	39	21	16	24	22
27	17	20	17	31	37	19	14	23	20
26	15	18	15	30	36	18	13	21	19
25	14	16	13	28	35	16	11	20	17
24	12	15	12	27	33	14	10	18	15
23	11	13	10	26	32	12	8	17	14
22	10	12	8	24	30	11	7	15	12
21	8	10	7	23	29	9	6	14	10
20	7	8	5	22	27	7	4	12	9
19	5	7	3	20	26	6	3	11	7
18	4	5	1	19	24	4	1	9	5
17	3	3		18	23	2		8	4
16	1	2		16	22			6	2
15				15	20			5	1
14				14	19			3	
13				12	17			2	
12				11	16				
11				10	14				
10				8	13				
9				7	12				
8				6	10				
7				4	9				
6				3	7				
5				2	6				
4					4				
3					3				
2					2				
1									

Motor Fitness Index IV
Height-Weight Class Divisions

Scale Score	SS	SM	SH	MS	MM	MH	TS	TM	TH
100		121	132	106	119	125	111	116	113
99	92	119	130	104	117	124	110	115	111
98	91	118	129	103	116	122	108	114	110
97	90	116	127	102	115	121	106	112	109
96	89	115	125	101	113	119	105	111	107
95	88	113	124	99	112	118	104	110	106
94	87	112	122	98	110	116	102	108	105
93	86	111	120	97	109	115	101	107	103
92	85	109	119	96	108	113	99	106	102
91	84	108	117	94	106	112	98	105	101
90	83	106	115	93	105	110	96	103	99
89	82	105	114	92	104	109	95	102	98
88	81	104	112	91	102	107	94	101	97
87	80	102	110	89	101	106	92	99	95
86	79	101	109	88	100	104	91	98	94
85	78	99	107	87	98	102	89	97	93
84	77	98	105	85	97	101	88	95	91
83	76	97	104	84	95	99	86	94	90
82	75	95	102	83	94	98	85	93	89
81	74	94	100	82	93	96	83	92	87
80		92	99	80	91	95	82	90	86
79	73	91	97	79	90	93	81	89	85
78	72	90	96	78	89	92	79	88	83
77	71	88	94	77	87	90	78	86	82
76	70	87	92	75	86	89	76	85	81
75	69	85	91	74	85	87	75	84	80
74	68	84	89	73	83	86	73	82	78
73	67	82	87	71	82	84	72	81	77
72	66	81	86	70	81	83	70	80	76
71	65	80	84	69	79	81	69	79	74
70	64	78	82	68	78	80	67	77	73
69	63	77	81	66	76	78	66	76	72
68	62	75	79	65	75	77	65	75	70
67	61	74	77	64	74	75	63	73	69
66	60	73	76	63	72	74	62	72	68
65	59	71	74	61	71	72	60	71	66
64	58	70	72	60	70	71	59	69	65
63	57	68	71	59	68	69	57	68	64
62	56	67	69	57	67	68	56	67	62
61		66	67	56	66	66	54	66	61
60	55	64	66	55	64	64	53	64	60
59	54	63	64	54	63	63	52	63	58
58	53	61	63	52	61	61	50	62	57
57	52	60	61	51	60	60	49	60	56
56	51	58	59	50	59	58	47	59	54
55	50	57	58	49	57	57	46	58	53
54	49	56	56	47	56	55	44	56	52
53	48	54	54	46	55	54	43	55	50
52	47	53	53	45	53	52	41	54	49
51	46	51	51	44	52	51	40	53	48
50	45	50	49	42	51	49	38	51	46
49	44	49	48	41	49	48	37	50	45
48	43	47	46	40	48	46	36	49	44
47	42	46	44	38	47	45	34	47	42
46	41	44	43	37	45	43	33	46	41
45	40	43	41	36	44	42	31	45	40
44	39	42	39	35	42	40	30	43	38
43	38	40	38	33	41	39	28	42	37
42	37	39	36	32	40	37	27	41	36
41	36	37	34	31	38	36	25	40	34
40		36	33	30	37	34	24	38	33
39	35	35	31	28	36	33	23	37	32
38	34	33	30	27	34	31	21	36	30
37	33	32	28	26	33	30	20	34	29
36	32	30	26	24	32	28	18	33	28
35	31	29	25	23	30	26	17	32	26
34	30	27	23	22	28	25	15	30	25
33	29	26	21	21	27	23	14	29	24
32	28	25	20	19	26	22	12	28	22
31	27	23	18	18	25	20	11	27	21

Motor Fitness Index IV (continued)
Height-Weight Class Divisions

Scale Score	SS	SM	SH	MS	MM	MH	TS	TM	TH
30	26	22	16	17	23	19	9	25	20
29	25	20	15	16	22	17	8	24	18
28	24	19	13	14	21	16	7	23	17
27	23	18	11	13	19	14	5	21	16
26	22	16	10	12	18	13	4	20	14
25	21	15	8	10	17	11	2	19	13
24	20	13	6	9	15	10	1	17	12
23	19	12	5	8	14	8		16	10
22	18	11	3	7	13	7		15	9
21		9	1	5	11	5		14	8
20	17	8		4	10	4		12	6
19	16	6		3	8	2		11	5
18	15	5		2	7	1		10	4
17	14	3			6			8	2
16	13	2			4			7	1
15	12	1			3			6	
14	11				2			4	
13	10							3	
12	9							2	
11	8							1	
10	7								
9	6								
8	5								
7	4								
6	3								
5	2								
4	1								
3									
2									
1									

Motor Fitness Index I
Classification Index

Scale Score	Up to 849	850-874	875-899	900-924	925-949	950-974	975 and up
100	129	133	139	137	137	125	150
99	127	131	137	136	136	123	148
98	126	130	135	134	134	122	146
97	124	128	134	133	133	121	145
96	123	126	132	131	131	119	143
95	121	125	131	130	129	118	141
94	120	124	129	128	128	116	139
93	118	122	127	126	126	115	137
92	117	120	126	125	125	113	135
91	115	119	124	123	123	112	133
90	113	117	123	122	121	110	131
89	112	115	121	120	120	109	129
88	110	114	119	119	118	107	127
87	109	112	118	117	117	106	126
86	107	111	116	115	115	104	124
85	106	109	114	114	113	103	122
84	104	108	113	112	112	102	120
83	103	106	111	111	110	100	118
82	101	104	110	109	109	99	116
81	100	103	108	108	107	97	114
80	98	101	106	106	105	96	112
79	97	100	105	104	104	94	110
78	95	98	103	103	102	93	108
77	93	97	101	101	100	91	107
76	92	95	100	100	99	90	105
75	90	93	99	98	97	88	103
74	89	92	97	97	96	87	101
73	87	90	95	95	94	85	99
72	86	89	93	93	92	84	97
71	74	87	92	92	91	83	95
70	83	86	90	90	89	81	93
69	81	84	88	89	88	80	91
68	80	82	87	87	86	78	89
67	78	81	85	86	84	77	88
66	77	79	84	84	83	75	86
65	75	78	82	82	81	74	84
64	73	76	80	81	80	72	82
63	72	75	79	79	78	71	80
62	70	73	77	78	76	69	78
61	69	71	76	76	75	68	76
60	67	70	74	75	73	67	74
59	66	68	72	73	72	65	72
58	64	67	71	71	70	64	70
57	63	65	69	70	68	62	69
56	61	64	67	68	67	61	67
55	60	62	66	67	65	59	65
54	58	60	64	65	63	58	63
53	56	59	63	64	62	56	61
52	55	57	61	62	60	55	59
51	53	56	59	60	59	53	57
50	52	54	58	59	57	52	55
49	50	53	56	57	55	50	53
48	49	51	54	56	54	49	51
47	47	49	53	54	52	48	50
46	46	48	51	53	51	46	48
45	44	46	50	51	49	45	46
44	43	45	48	50	47	43	44
43	41	43	46	48	46	42	42
42	40	42	45	46	44	40	40
41	38	40	43	45	43	39	38
40	36	38	42	43	41	37	36
39	35	37	40	42	39	36	34
38	33	35	38	40	38	34	32
37	32	34	37	38	36	33	31
36	30	32	35	37	34	31	29
35	29	31	33	35	33	30	27
34	27	29	32	34	31	29	25
33	26	27	30	32	30	27	23
32	24	26	29	31	28	26	21
31	23	24	27	29	26	24	19

Motor Fitness Index I (continued)
Classification Index

Scale Score	Up to 849	850-874	875-899	900-924	925-949	950-974	975 and up
30	21	23	25	27	25	23	17
29	20	21	23	26	23	21	15
28	18	20	22	24	22	20	13
27	16	18	20	23	20	18	12
26	15	16	19	21	18	17	10
25	13	15	17	20	17	15	8
24	12	13	16	18	15	14	6
23	10	12	14	16	14	12	4
22	9	10	12	15	12	11	2
21	7	9	11	13	10	10	
20	6	7	9	12	9	8	
19	4	5	7	10	7	7	
18	3	4	6	9	5	5	
17	1	2	4	7	4	4	
16		1	3	5	2	2	
15			1	4	1	1	
14				2			
13				1			
12							
11							
10							
9							
8							
7							
6							
5							
4							
3							
2							
1							

Motor Fitness Index II
Classification Index

Scale Score	Up to 849	850-874	875-899	900-924	925-949	950-974	975 and up
100	101	124	124	125	117	122	127
99	100	122	123	123	115	120	125
98	99	121	121	122	114	119	123
97	98	119	120	120	113	117	122
96	97	118	118	119	111	116	120
95	96	116	117	117	110	114	118
94	94	115	115	116	108	113	117
93	93	113	114	114	107	111	115
92	92	112	112	113	106	110	113
91	91	110	111	111	104	108	112
90	90	109	109	110	103	107	110
89	88	107	108	108	101	105	108
88	87	106	106	107	100	103	106
87	86	104	105	105	99	102	105
86	85	103	103	104	97	100	103
85	84	101	102	103	96	99	101
84	83	99	100	101	94	97	100
83	81	98	99	100	93	96	98
82	80	96	97	98	92	94	96
81	79	95	96	97	90	93	95
80	78	93	94	95	89	91	93
79	77	92	93	94	88	90	91
78	75	90	92	92	86	88	90
77	74	89	90	91	85	87	88
76	73	87	89	89	83	85	86
75	72	86	87	88	82	84	85
74	71	84	86	86	81	82	83
73	70	83	84	85	79	81	81
72	68	81	83	83	78	79	80
71	67	80	81	82	76	78	78
70	66	78	80	80	75	76	76
69	65	77	78	79	74	75	75
68	64	75	77	77	72	73	73
67	62	74	75	76	71	72	71
66	61	72	74	74	69	70	70
65	60	71	72	73	68	69	68
64	59	69	71	71	67	67	66
63	58	68	69	70	65	66	64
62	57	66	68	68	64	64	63
61	55	65	66	67	62	63	61
60	54	63	65	65	61	61	59
59	53	61	63	64	60	60	58
58	52	60	62	62	58	58	56
57	51	58	60	61	57	57	54
56	50	57	59	59	56	55	53
55	48	55	57	58	54	54	51
54	47	54	56	56	53	52	49
53	46	52	55	55	51	51	48
52	45	51	53	53	50	49	46
51	44	49	52	52	49	48	44
50	42	48	50	50	47	46	43
49	41	46	49	49	46	45	41
48	40	45	47	47	44	43	39
47	39	43	46	46	43	42	38
46	38	42	44	44	42	40	36
45	37	40	43	43	40	39	34
44	35	39	41	41	39	37	33
43	34	37	40	40	37	36	31
42	33	36	38	38	36	34	29
41	32	34	37	37	35	33	28
40	31	33	35	35	33	31	26
39	29	31	34	34	32	29	24
38	28	30	33	32	31	27	22
37	27	28	31	31	29	26	21
36	26	27	29	29	28	25	19
35	25	25	28	28	26	23	17
34	24	23	26	27	25	22	16
33	22	22	25	25	24	20	14
32	21	20	23	24	22	19	12
31	20	19	22	22	21	17	11

Motor Fitness Index II (continued)
Classification Index

Scale Score	Up to 849	850-874	875-899	900-924	925-949	950-974	975 and up
30	19	17	20	21	19	16	9
29	18	16	19	19	18	14	7
28	16	14	18	18	17	13	6
27	15	13	16	16	15	11	4
26	14	11	15	15	14	10	2
25	13	10	13	13	12	8	1
24	12	8	12	12	11	7	
23	11	7	10	10	10	5	
22	9	5	9	9	8	4	
21	8	4	7	7	7	2	
20	7	2	6	6	6	1	
19	6	1	4	4	4		
18	5		3	3	3		
17	3		1	1	1		
16	2						
15	1						
14							
13							
12							
11							
10							
9							
8							
7							
6							
5							
4							
3							
2							
1							

Motor Fitness Index III
Classification Index

Scale Score	Up to 849	850-874	875-899	900-924	925-949	950-974	975 and up
100	129	125	127	150	137	132	151
99	127	123	126	149	136	131	149
98	126	122	124	147	134	129	147
97	124	120	123	145	133	128	145
96	123	119	122	143	131	126	143
95	121	118	120	141	129	124	141
94	119	116	119	139	128	123	139
93	118	115	117	138	126	121	138
92	116	113	116	136	125	120	136
91	115	112	114	134	123	118	134
90	113	110	113	132	121	117	132
89	112	109	112	130	120	115	130
88	110	107	110	129	119	114	128
87	109	106	109	127	117	112	127
86	107	104	107	125	115	110	125
85	106	103	106	123	114	109	123
84	104	102	105	121	112	108	121
83	102	100	103	120	111	106	119
82	101	99	102	118	109	105	117
81	99	97	100	116	108	103	115
80	98	96	99	114	106	101	114
79	96	94	97	112	105	100	112
78	95	93	96	111	103	99	110
77	93	91	95	109	101	97	108
76	92	90	93	107	100	96	106
75	90	88	92	105	98	94	104
74	88	87	90	103	97	93	102
73	87	85	89	101	95	91	101
72	85	84	88	100	94	90	99
71	84	83	86	98	92	88	97
70	82	81	85	96	90	86	95
69	81	80	83	94	89	85	93
68	79	78	82	92	87	83	91
67	78	77	80	91	86	82	90
66	76	75	79	89	84	80	88
65	75	74	78	87	83	79	86
64	73	72	76	85	81	77	84
63	71	71	75	83	80	76	82
62	70	69	73	82	78	74	80
61	68	68	72	80	76	73	78
60	67	66	70	78	75	71	77
59	65	65	69	76	73	70	75
58	64	64	68	74	72	68	73
57	62	62	66	73	70	67	71
56	61	61	65	71	69	65	69
55	59	59	63	69	67	64	67
54	57	58	62	67	66	62	65
53	56	56	61	65	64	61	64
52	54	55	59	63	62	59	62
51	53	53	58	62	61	58	60
50	51	52	56	60	59	56	58
49	50	50	55	58	58	55	56
48	48	49	53	56	56	53	54
47	47	47	52	54	55	52	53
46	45	46	51	53	53	50	51
45	44	45	49	51	51	48	49
44	42	43	48	49	50	47	47
43	40	42	46	47	48	45	45
42	39	40	45	45	47	44	43
41	37	39	43	44	45	42	41
40	36	37	42	42	44	41	40
39	34	36	41	40	42	39	38
38	33	34	39	38	41	38	36
37	31	33	38	36	39	35	34
36	30	31	36	35	37	34	32
35	28	30	35	33	36	33	30
34	26	29	34	31	34	32	28
33	25	27	32	29	33	30	27
32	23	26	31	27	31	29	25
31	22	24	29	25	30	27	23

Motor Fitness Index III (continued)
Classification Index

Scale Score	Up to 849	850-874	875-899	900-924	925-949	950-974	975 and up
30	20	23	28	24	28	26	21
29	19	21	26	22	27	24	19
28	17	20	25	20	25	23	17
27	16	18	24	18	23	21	16
26	14	17	22	16	22	20	14
25	13	15	21	15	20	18	12
24	11	14	19	13	19	17	10
23	9	12	18	11	17	15	8
22	8	11	17	9	16	14	6
21	6	10	15	7	14	12	4
20	5	8	14	6	12	10	3
19	3	7	12	4	11	9	1
18	2	5	11	2	9	7	
17		4	9		8	6	
16		2	8		6	4	
15		1	7		5	3	
14			5		3	1	
13			4		2		
12			2				
11			1				
10							
9							
8							
7							
6							
5							
4							
3							
2							
1							

Motor Fitness Index IV
Classification Index

Scale Score	Up to 849	850-874	875-899	900-924	925-949	950-974	975 and up
100	118	113	120	125	119	121	128
99	116	111	119	123	117	120	127
98	115	110	117	122	116	118	125
97	113	109	116	121	115	117	123
96	111	107	114	119	113	115	122
95	110	106	113	118	112	114	120
94	108	105	112	116	110	113	118
93	107	103	110	115	109	111	116
92	105	102	109	113	108	110	115
91	104	101	107	112	106	108	113
90	102	99	106	110	105	107	111
89	101	98	105	109	103	105	110
88	99	97	103	107	102	104	108
87	98	95	102	106	101	102	106
86	96	94	100	104	99	101	105
85	94	93	99	103	98	99	103
84	93	91	97	101	96	98	101
83	91	90	96	100	95	96	100
82	90	89	95	98	94	95	98
81	88	87	93	97	92	94	96
80	87	86	92	95	91	92	95
79	85	85	90	94	89	91	93
78	84	83	89	92	88	89	91
77	82	82	87	91	87	88	89
76	80	80	86	89	85	86	88
75	79	79	85	88	84	85	86
74	77	78	83	86	82	83	84
73	76	76	82	85	81	82	83
72	74	75	80	84	80	80	81
71	73	74	79	82	78	79	79
70	71	72	78	81	77	77	78
69	70	71	76	79	75	76	76
68	68	70	75	78	74	75	74
67	67	68	73	76	73	73	73
66	65	67	72	75	71	72	71
65	63	66	70	73	70	70	69
64	62	64	69	72	68	69	67
63	60	63	68	70	67	67	66
62	59	62	66	69	66	66	64
61	57	60	65	67	64	64	62
60	56	59	63	66	63	63	61
59	54	58	62	64	61	61	59
58	53	56	61	63	60	60	57
57	51	55	59	61	59	59	56
56	49	54	58	60	57	57	54
55	48	52	56	58	56	56	52
54	46	51	55	57	54	54	51
53	45	50	53	55	53	53	49
52	43	48	52	54	52	51	47
51	42	47	51	52	50	50	45
50	40	46	49	51	49	48	44
49	39	44	48	49	47	47	42
48	37	43	46	48	46	45	40
47	36	42	45	47	45	44	39
46	34	40	43	45	43	42	37
45	32	39	42	44	42	41	35
44	31	38	41	42	40	40	34
43	29	36	39	41	39	38	32
42	28	35	38	39	38	37	30
41	26	34	36	38	36	35	29
40	25	32	35	36	35	34	27
39	23	31	34	35	33	32	25
38	22	30	32	33	32	31	24
37	20	28	31	32	31	29	22
36	19	27	29	30	29	28	20
35	17	26	28	29	28	26	18
34	15	24	26	27	26	25	17
33	14	23	25	26	25	23	15
32	12	22	24	24	24	22	13
31	11	20	22	23	22	21	12

Motor Fitness Index IV (continued)
Classification Index

Scale Score	Up to 849	850-874	875-899	900-924	925-949	950-974	975 and up
30	9	19	21	21	21	19	10
29	8	18	19	20	19	18	8
28	6	16	18	18	18	16	7
27	5	15	16	17	17	15	5
26	3	13	15	15	15	13	3
25	1	12	14	14	14	12	2
24		11	12	12	12	10	
23		9	11	11	11	9	
22		8	9	10	10	7	
21		7	8	8	8	6	
20		5	7	7	7	5	
19		4	5	5	5	3	
18		3	4	4	4	2	
17		1	2	2	3		
16			1	1	1		
15							
14							
13							
12							
11							
10							
9							
8							
7							
6							
5							
4							
3							
2							
1							

TEST MANUAL
for
INDIANA UNIVERSITY MOTOR FITNESS INDICES FOR COLLEGE AGE MEN

KARL W. BOOKWALTER

HISTORY OF THE INDICES

IN an effort to establish a simple, valid, and inexpensive test of motor fitness, the utilization of Index I (chins-plus-push-ups times vertical jump) was justified by a previous study.[1] This simplification of previously established tests had a validity coefficient of .831 ± .01 with a criterion of 20 items in that study. A validity coefficient of .859 ± .01 with a more select criterion of 12 items was obtained in a recent unpublished study of the same source.

Since the development of Index I, a new type of partner chinning (straddle chins) has been designed by the author. No equipment is needed for this form of chinning. McCloy has further suggested the substitution of standing broad jump for vertical jump. Accordingly, in the interests of greater simplification and adaptability, the following four indices have been developed and validated:

Motor Fitness Index I (chins-plus-push-ups times vertical jump)[2]
Motor Fitness Index II (chins-plus-push-ups times standing broad jump)
Motor Fitness Index III (partner-chins-plus-push-ups times vertical jump)
Motor Fitness Index IV (partner-chins-plus-push-ups times standing broad jump)

The 12-item criterion against which these indices were validated involved two or more measures each of strength, velocity, motor ability, and endurance. The validities of these indices with this criterion were .859 ± .01, .818 ± .01, .841 ± .01, and .812 ± .01, respectively.

Since all of these coefficients are high and of reasonably approximate value, it would appear that instructors would be justified in utilizing that index which is most feasible with respect to their equipment and self-testing program. However, other things being equal, it seems obvious from this last study that Indices I and III are preferable.

THE USES OF MOTOR FITNESS INDICES

There are three principal uses for these indices, the most obvious of which is the measurement of achievement of secondary school boys and college men in physical fitness programs including a wider range of activities than is included in the test itself. These indices

[1] Bookwalter, Karl W., and Bookwalter, Carolyn W., *A Measure of Motor Fitness for College Men*, Indiana University, Bulletin of the School of Education, Vol. XIX, No. 2, Bloomington, 1943, 26 pp.

[2] All items are modified T-scored ($6\sigma/100$).

involve measures of strength and velocity but are combined according to the power principle ($P = F \times V$).

Secondly, gains in achievement for the body types quite logically and justly could be used as a basis for a partial mark in the physical education service program. (The accompanying achievement scales will be helpful for this purpose.)

Third, the use of these Motor Fitness Indices as the functional and primary classifier in an administrative ability grouping involving Classification Index I (McCloy) as the secondary structural classifier has been carefully established statistically and is explained in this study. This administrative combination of strength or power measures with structural measures is in harmony with recommendations by McCloy, Brace, Rogers, and others.

A *Motor Fitness Index* can be given in one 50-minute period to a large number of men (60 or more). The class should be divided into groups. One half of the class should be given the chins and vertical jump (or standing broad jump) under their squad leaders. The other half should be re-divided into halves. One half of this latter group should do the push-ups while the other half records. The push-up groups should then exchange—the former recorders doing the push-ups which are recorded by the former performers. The two *halves of the class* should then exchange so that all get the chins, push-ups, and vertical jump. If the straddle chins are used, half the class can do the chins and push-ups while the other half is scored by squads on the vertical or standing broad jump. The halves are then reversed.

1. The chins may be performed with any grip. No half credits are permitted and the chin must clear the bar on each pull-up. Arms must be fully extended on the return. No swinging or kicking is allowed, although an assistant may steady the legs of the chinner. The chins must be executed regularly without rest.

2. For straddle chinning, the class is sized and they count off in twos. Numbers one lie on their backs with arms sideward shoulder level on the floor. Upper arm is bent to vertical. Numbers two stand astride and facing numbers one, feet outside and touching elbows of ones. Partners then clasp hands, bent finger hold, and numbers one chin upward as often as possible. Chest should meet firm resistance with partners' thighs each time. Both partners keep legs and back straight. Arms of supporting partner are straight throughout. Partners next change places and repeat as before.

3. The push-ups are executed from a front support. The chest must touch the floor each time and the arms must be fully straightened on the return. The back must be kept straight. No partial credits are allowed and the dips must be done regularly with no rest in between.

4. The vertical jump is made to a blackened plywood board five feet long and one foot wide, suspended from a basketball backstop. The jumper toes a line one foot in front of the board. If boards are not available, the jumper can face a wall. The index finger is chalked with magnesium. The jumper reaches as far as possible with the

heels kept on the floor and makes a mark on the board with the chalked finger. Next he executes three jumps vertically from a crouch, making a mark each time upon the board. The distance from the *top* of the reach mark to the *top* of the *highest* jump mark is recorded as the vertical jump. It should be measured to the last quarter of an inch.

5. The contestant toes a line which is four feet from the pit, or the first 6″ mark on the mat, and springs forward off of both feet. The nearest point touched by *any* part of his body at right angles to the take-off line is his jump. It should be measured to the nearest inch. If jumping on the mat, lines may be marked in 6″ intervals and the nearest inches estimated.

MOTOR FITNESS INDEX SCORE CARD
Department of Physical Education for Men
Indiana University

Name .....Section.....

Dates of Tests								
	Scores							
	Raw	T-sc	Raw	T-sc	Raw	T-sc	Raw	T-sc
1. Chins, or straddle chins*								
2. Push-ups								
Sum of T-scores								
	To be multiplied by T-score of							
3. Vertical or standing broad jump...								
which gives the								
4. MOTOR FITNESS INDEX								
Gains in percentage.....								
M.F.I. Classification (S,G,N,P,I)								

* Comparisons in retests must always be of the same items (same index).

DIRECTIONS FOR SCORING MOTOR FITNESS INDEX

The above individual *Motor Fitness Index Score Card* permits comparisons with past records and with school or present norms. Assume that the raw scores of John Doe in Motor Fitness Index I are as follows:

Chins	6 times
Push-ups	18 times
Vertical jump	18.25 inches

"Scale Scores for Motor Fitness Index Items," pages 43 and 44, show that 6 chins earn a score of 44 points and 18 push-ups earn a score of 55 points. The sum of these two force items is 99 points. On the same sheet we find that a vertical jump of 18.25″ gets 35 points. By multiplying the sum of the scale scores earned on the chins and push-ups (99) by the scale score earned on the vertical jump (35),

a product of 3,465 is obtained. This product is divided by 100 for simplicity and rounding to the nearest whole number. The resulting number, 35, is the Indiana University Motor Fitness Index for this individual.

The following norms are based upon 705 Indiana University men in the physical fitness program. The group was composed of both beginning and advanced men in about equal proportions and should be fairly representative.

Per cent of total group	Class intervals	Rating
7	85 and up	Superior
24	59-84	Good
38	33-58	Normal (average)
24	7-32	Poor
7	6 or less	Inferior

According to these norms, the hypothetical score, figured above to be 35, is average or normal. The class intervals for these norms are determined as follows: between $-.5\sigma$ and $+.5\sigma$ are fair, above $+.5\sigma$ and up to $+1.5\sigma$ are good, and above $+1.5\sigma$ are superior. Similarly, all below $-.5\sigma$ but not below -1.5σ are poor, and all below -1.5σ are inferior. Local norms for high school boys and college men in all four indices should be determined on this basis, since many factors determine results from these tests. Among these factors are (1) age, height, and weight of participants, (2) time allotted to the physical fitness program, (3) nature and intensity of the program activities, (4) previous state of fitness of participants, and (5) the amount of drill devoted to the items involved in the indices themselves.

SCALE SCORES FOR MOTOR FITNESS INDEX ITEMS

(Modified T-scores $\frac{6\sigma}{100}$)

Scale score	Raw scores					Scale score
	Chins	Straddle chins	Push-ups	Vertical jump	Standing broad jump	
100	17	35	36	29.75	110	100
99				29.50		99
98				29.25	109	98
97		34	35	29.00		97
96	16				108	96
95			34	28.75		95
94		33		28.50	107	94
93						93
92		32	33	28.25	106	92
91	15			28.00		91
90			32		105	90
89		31		27.75		89
88				27.50	104	88
87			31	27.25		87
86	14	30				86
85			30	27.00	103	85
84				26.75		84
83		29			102	83
82			29	26.50		82
81	13	28		26.25	101	81
80			28			80
79				26.00	100	79
78		27		25.75		78
77			27	25.50	99	77
76						76
75	12	26	26	25.25	98	75
74				25.00		74
73		25			97	73
72			25	24.75		72
71				24.50	96	71
70	11	24	24	24.25		70
69					95	69
68				24.00		68
67		23	23	23.75	94	67
66						66
65	10	22	22	23.50	93	65
64				23.25		64
63					92	63
62		21	21	23.00		62
61				22.75	91	61
60	9		20	22.50		60
59		20			90	59
58				22.25		58
57		19	19	22.00	89	57
56						56
55			18	21.75	88	55
54	8	18		21.50		54
53					87	53
52			17	21.25		52
51		17		21.00	86	51
50			16	20.75		50
49	7	16			85	49
48				20.50		48
47			15	20.25	84	47
46		15				46
45			14	20.00	83	45
44	6			19.75		44
43		14		19.50	82	43
42			13			42
41		13		19.25	81	41
40			12	19.00		40
39	5				80	39
38		12		18.75		38
37			11	18.50	79	37
36						36
35		11	10	18.25	78	35
34	4			18.00		34
33		10		17.75	77	33
32			9			32
31				17.50	76	31

SCALE SCORES FOR MOTOR FITNESS INDEX ITEMS (continued)

Scale score	Raw scores					Scale score
	Chins	Straddle chins	Push-ups	Vertical jump	Standing broad jump	
30		9	8	17.25		30
29						29
28	3			17.00	75	28
27		8	7	16.75		27
26				16.50	74	26
25		7	6			25
24				16.25	73	24
23	2			16.00		23
22		6	5		72	22
21				15.75		21
20			4	15.50	71	20
19		5				19
18	1			15.25	70	18
17		4	3	15.00		17
16				14.75	69	16
15			2			15
14		3		14.50	68	14
13				14.25		13
12			1		67	12
11		2		14.00		11
10				13.75	66	10
9		1		13.50		9
8					65	8
7				13.25		7
6				13.00	64	6
5						5
4				12.75	63	4
3				12.50		3
2					62	2
1				12.25		1

A List of Bulletins in the Field of Education, Indiana University

By Kathleen Dugdale

The School of Education at Indiana University has published the following bulletins. All of these may be obtained from the University Bookstore for 50 cents postpaid unless otherwise noted.

Proceedings of the High School Principals' Conference (November 23 and 24, 1923). Vol. I, No. 1, 1924. 85 p. (Supply exhausted.)

Investigation of Nursing as a Professional Opportunity for Girls, Part I, Technical Study; Part II, Vocational Information Bulletin. By Florence E. Blazier. Vol. I, No. 2, 1924. 69 p.

Proceedings of the Eleventh Conference on Educational Measurements. Vol. I, No. 3, 1925. 141 p.

Proceedings of the High School Principals' Conference (November 14 and 15, 1924). Vol. I, No. 4, 1925. 49 p. (Supply exhausted.)

First Revision of the Bibliography of Educational Measurements. Compiled by the Bureau of Cooperative Research. Vol. I, No. 5, 1925. 147 p. (Supply exhausted.)

Proceedings of the Twelfth Conference on Educational Measurements. Vol. I, No. 6, 1925. 76 p.

The Effect of Population upon Ability to Support Education. By Harold F. Clark. Vol. II, No. 1, 1925. 28 p.

Proceedings of the High School Principals' Conference (November 20 and 21, 1925). Vol. II, No. 2, 1925. 77 p. (Supply exhausted.)

A Cross-Indexed Bibliography on School Budgets. By Harold F. Clark. Vol. II, No. 3, 1926. 66 p.

A Comparison of the Results Made on Certain Standardized Tests by Pupils in the Bloomington High School Who Were Taught in Classes of the Same Grade by University Student Teachers and by Regular High School Teachers. By Carl G. F. Franzén. Vol. II, No. 4, 1926. 19 p.

Proceedings of the Thirteenth Annual Conference on Educational Measurements. Vol. II, No. 5, 1926. 103 p.

When to Issue School Bonds. By Harold Florian Clark and Paul Royalty. Vol. II, No. 6, 1926. 16 p.

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Proceedings of the Fourteenth Annual Conference on Educational Measurements. Vol. III, No. 6, 1927. 66 p.

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Second Revision of the Bibliography of Educational Measurements. By Henry Lester Smith and Wendell William Wright. Vol. IV, No. 2, 1927. 251 p. (75¢)

Bibliography of School Buildings, Grounds, and Equipment, Part I. By Henry Lester Smith and Leo Martin Chamberlain. Vol. IV, No. 3, 1928. 326 p. (75¢)

Proceedings of the High School Principals' Conference (November 18 and 19, 1927). Vol. IV, No. 4, 1928. 54 p.

The Economic Effects of Education. By Harold F. Clark. Vol. IV, No. 5, 1928. 39 p.

Proceedings of the Fifteenth Annual Conference on Educational Measurements. Vol. IV, No. 6, 1928. 73 p.

Proceedings of the Fifth Annual Conference on Elementary Supervision. Vol. V, No. 1, 1928. 54 p.

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Tentative Program for Teaching World Friendship and Understanding in Teacher Training Institutions and in Public Schools for Children Who Range from Six to Fourteen Years of Age. By Henry Lester Smith and Sherman Gideon Crayton. Vol. V, No. 5, 1929. 54 p.

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